

THURSDAY, JUNE 15, 1882

CHARLES DARWIN¹

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IN attempting to estimate the influence which Mr. Darwin's writings have exerted on the progress of botanical science, a little consideration will show that we must discriminate between the indirect effect which his views have had on botanical research generally, and the direct results of his own contributions. No doubt in a sense the former will seem in the retrospect to overshadow the latter. For in his later writings Mr. Darwin was content to devote himself to the consideration of problems—with an insight and patience essentially his own—which, in a limited field, brought his theoretical views to a detailed test, and so may ultimately seem to be somewhat merged in them. It is wonderful enough that so great a master in biological science should, at an advanced age, have been content to work with all the fervour and assiduity of youth at phenomena of vegetable life apparently minute and of the most special kind. But to him they were not minute, but instinct with a significance that the professed botanical world had for the most part missed seeing in them failing the point of view which Mr. Darwin himself supplied. It is not too much to say that each of his botanical investigations, taken on its own merits, would alone have made the reputation of any ordinary botanist.

Mr. Darwin's attitude towards botany, as indeed to biological studies generally, it should always be remembered was in his early life essentially that of a naturalist of the school of Linnæus and Humboldt—a point of view unfortunately now perhaps a little out of fashion. Nature in all its aspects spoke to his feelings with a voice that was living and direct. The writer of these lines can well remember the impression which it made upon him to hear Mr. Darwin gently complain that some of this warm enthusiasm for nature, as it presents itself unanalysed to ordinary healthy vision, seemed to be a little dulled in the younger naturalists of the day, who were apt to be somewhat cramped by the limits of their work-rooms. The pages of the "Journal of Researches" show no such restraint, but abound with passages in which Mr. Darwin's ever unstudied and simple language is carried by the force of warm impression and a perfect joy in nature to a level of singular beauty. One passage may be quoted as an illustration; it is from the description of Bahia in Chapter xxi. :—

"When quietly walking along the shady pathways, and admiring each successive view, I wished to find language to express my ideas. Epithet after epithet was found too weak to convey to those who have not visited the inter-tropical regions, the sensation of delight which the mind experiences. I have said that the plants in a hothouse fail to communicate a just idea of the vegetation, yet I must recur to it. The land is one great wild, untidy, luxuriant hothouse, made by Nature for herself, but taken possession of by man, who has studded it with gay houses and formal gardens. How great would be the desire in every admirer of nature to behold, if such were possible, the scenery of another planet! Yet to every person in Europe, it may be truly said, that at the dis-

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tance of only a few degrees from his native soil, the glories of another world are opened to him. In my last walk I stopped again and again to gaze on these beauties, and endeavoured to fix in my mind for ever, an impression which at the time I knew sooner or later must fail. The form of the orange-tree, the cocoa-nut, the palm, the mango, the tree-fern, the banana, will remain clear and separate; but the thousand beauties which unite these into one perfect scene must fade away; yet they will leave, like a tale heard in childhood, a picture full of indistinct, but most beautiful figures."

A spirit such as this, penetrating an intelligence such as Mr. Darwin's, would not content itself with the superficial interest of form and colour. These, in his eyes, were the outward and visible signs of the inner *arcana*. The fascination of sense which the former imposed upon him but stimulated his desire to unveil the latter. In the Galapagos we are not then surprised to find him ardently absorbed in the problems which the extraordinary distribution of the plants, no less than of other organisms, presented :—

"I indiscriminately collected everything in flower on the different islands, and fortunately kept my collections separate."

After tabulating the results which they yielded after systematic determination, he proceeds :

"Hence we have the truly wonderful fact, that in James Island, of the thirty-eight Galapageian plants, or those found in no other part of the world, thirty are exclusively confined to this one island; and in Albemarle Island, of the twenty-six aboriginal Galapageian plants, twenty-two are confined to this one island, that is, only four are known to grow on the other islands of the Archipelago; and so on, as shown in the above table, with the plants from Chatham and Charles Island."

It is impossible in reading the *Origin of Species* not to perceive how deeply Mr. Darwin had been impressed by the problems presented by such singularities of plant distribution as he met with in the Galapagos. And of such problems up to the time of its publication no intelligible explanation had seemed possible. Sir Joseph Hooker had indeed prepared the ground by bringing into prominence, in numerous important papers, the no less striking phenomena which were presented when the vegetation of large areas came to be analysed and compared. No one therefore could estimate more justly what Mr. Darwin did for those who worked in this field. How the whole matter stood after the publication of the *Origin of Species* cannot be better estimated than from the summary of the position contained in Sir Joseph Hooker's recent address to the Geographical Section of the meeting of the British Association at York.

"Before the publication of the doctrine of the origin of species by variation and natural selection, all reasoning on their distribution was in subordination to the idea that these were permanent and special creations; just as, before it was shown that species were often older than the islands and mountains they inhabited, naturalists had to make their theories accord with the idea that all migration took place under existing conditions of land and sea. Hitherto the modes of dispersion of species, genera, and families had been traced, but the origin of representative species, genera, and families, remained an enigma; these could be explained only by the supposition that the localities where they occurred presented conditions so similar that they favoured the creation of similar organisms which failed to account for representation occurring in

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the far more numerous cases where there is no discoverable similarity of physical conditions, and of their not occurring in places where the conditions are similar. Now under the theory of modification of species after migration and isolation, their representation in distant localities is only a question of time, and changed physical conditions. In fact, as Mr. Darwin well sums up, all the leading facts of distribution are clearly explicable under this theory; such as the multiplication of new forms, the importance of barriers in forming and separating zoological and botanical provinces; the concentration of related species in the same area; the linking together under different latitudes of the inhabitants of the plains and mountains, of the forests, marshes, and deserts, and the linking of these with the extinct beings which formerly inhabited the same areas; and the fact of different forms of life occurring in areas having nearly the same physical conditions."

If Mr. Darwin had done no more than this in the botanical field he would have left an indelible mark on the progress of botanical science. But the consideration of the various questions which the problem of the Origin of Species presented led him into other inquiries in which the results were scarcely less important. The key-note of a whole series of his writings is struck by the words with which the eighth chapter of the Origin of Species commences:—

"The view generally entertained by naturalists is that species, when intercrossed, have been specially endowed with the quality of sterility, in order to prevent the confusion of all organic forms."

The examination of this principle necessarily obliged him to make a profound study of the conditions and limits of sterility. The results embodied in his well-known papers on dimorphic and trimorphic plants afforded an absolutely conclusive proof that sterility was not inseparably tied up with specific divergence. But the question is handled in the most judicial way, and when the reader of the chapter on hybridism arrives at the concluding words in which Mr. Darwin declares that on this ground "there is no fundamental distinction between species and varieties," he finds himself in much the same intellectual position as is produced by the Q.E.D. at the end of a geometrical demonstration.

It was characteristic of Mr. Darwin's method to follow up on its own account, as completely as possible, when opportunity presented, any side issue which had been raised apparently incidentally in other discussions. Indeed it was never possible to guess what amount of evidence Mr. Darwin had in reserve behind the few words which marked a mere step in an argument. It was this practice of bringing out from time to time the contents of his unseen treasure-house which affords some insight into the scientific energy of his later years, at first sight so inexplicably prolific. Many of his works published during that period may be properly regarded in the light of excursions on particular points of his great theory. The researches on the sexual phenomena of heterostyled plants, alluded to above, which were communicated to the Linnean Society in a series of papers ranging over the years 1862-8, ultimately found their complete development in the volume "On the Different Forms of Flowers or Plants of the same Species," published in 1877. In the same way, the statement in the Origin of Species, that "the crossing of forms only slightly dif-

ferentiated, favours the vigour and fertility of their offspring," finds its complete expansion in "The Effects of Cross and Self-Fertilisation in the Vegetable Kingdom," published in 1876.

The "Origin of Species" in the form in which it has become a classic in scientific literature was originally only intended as a preliminary *précis* of a vast accumulation of facts and arguments which the author had collected. It was intended to be but the precursor of a series of works in which all the evidence was to be methodically set out and discussed. Of this vast undertaking only one, the "Variation of Plants and Animals under Domestication" was ever actually published. Apart from its primary purpose it produced a profound impression, especially on botanists. This was partly due to the undeniable force of the argument from analogy stated in a sentence in the introduction:—"Man may be said to have been trying an experiment on a gigantic scale; and it is an experiment which nature, during the long lapse of time has incessantly tried." But it was still more due to the unexpected use of the vast body of apparently trivial facts and observations which Mr. Darwin with astonishing industry had disinterred from weekly journals and ephemeral publications of all sorts and unexpectedly forced into his service. Like Molière's Monsieur Jourdain, who was delighted to find that he had been unwittingly talking prose all his life, horticulturists who had unconsciously moulded plants almost at their will at the impulse of taste or profit were at once amazed and charmed to find that they had been doing scientific work and helping to establish a great theory. The criticism of practical men, at once most tenacious and difficult to meet, was disarmed; these found themselves hoist with their own petard. Nor was this all. The exclusive province of science was in biological phenomena for ever broken down; every one whose avocations in life had to do with the rearing or use of living things, found himself a party to the "experiment on a gigantic scale," which had been going on ever since the human race withdrew for their own ends plants or animals from the feral and brought them into the domesticated state.

Mr. Darwin with characteristic modesty had probably underrated the effect which the "Origin of Species" would have as an argumentative statement of his views. It probably ultimately seemed to him unnecessary to submit to the labour of methodising the vast accumulations which he had doubtless made for the second and third instalments of the detailed exposition of the evidence which he had promised. As was hinted at the commencement of this article, his attention was rather drawn away from the study of evidence already at the disposal of those who cared to digest and weigh it to the exploration of the field of nature with the new and penetrating instrument of research which he had forged. Something too must be credited to the intense delight which he felt in investigating the phenomena of living things. But he doubtless saw that the work to be done was to show how morphological and physiological complexity found its explanation from the principle of natural selection. This is the idea which is ever dominant. Thus he concludes his work on climbing plants:—"It has often been vaguely asserted that plants are distinguished from animals by not having the powers of movement. It should

rather be said that plants acquire and display this power only when it is of some advantage to them; this being of comparatively rare occurrence, as they are affixed to the ground, and food is brought to them by the air and rain." The diversity of the power of movement in plants naturally engaged his attention, and the last but one of his works—in some respects perhaps the most remarkable of them—was devoted to showing that these could be regarded as derived from a single fundamental property. "All the parts or organs of every plant while they continue to grow . . . are continually circumnuting." Whether this masterly conception of the unity of what has hitherto seemed a chaos of unrelated phenomena will be sustained time alone will show. But no one can doubt the importance of what Mr. Darwin has done in showing that for the future the phenomena of plant movement can and indeed must be studied from a single point of view.

Along another line of work Mr. Darwin occupied himself with showing what aid could be given by the principle of natural selection in explaining the extraordinary variety of detail in plant morphology. The fact that cross-fertilisation was an advantage, was the key with which, as indicated in the pages of the "Origin of Species," the bizarre complexities of orchid flowers could be unlocked. The detailed facts were set out in a well-known work, and the principle is now generally accepted with regard to flowers generally. The work on insectivorous plants gave the results of an exploration similar in its object and bringing under one common physiological point of view a variety of the most diverse and most remarkable modifications of leaf-form.

In the beginning of this article the attempt has already been made to do justice to the mark Mr. Darwin has left on the modern study of geographical botany (and that implies a corresponding influence on physio-palæontology). To measure the influence which he has had on any other branches of botany, it is sufficient to quote again from the "Origin of Species":—"The structure of each part of each species, for whatever purpose used, will be the sum of the many inherited changes, through which that species has passed during its successive adaptations to changed habits and conditions of life." These words may almost be said to be the key-note of Sachs's well-known text-book, which is regarded as the most authoritative modern exposition of the facts and principles of plant-structure and function. And there is probably not a botanical class-room or work-room in the civilised world, where they are not the animating principle of both instruction and research.

Notwithstanding the extent and variety of his botanical work, Mr. Darwin always disclaimed any right to be regarded as a botanist. He turned his attention to plants doubtless because they were convenient objects for studying organic phenomena in their least complicated forms; and this point of view, which if one may use the expression without disrespect, had something of the amateur about it, was in itself of the greatest importance. For, from not being, till he took up any point, familiar with the literature bearing on it, his mind was absolutely free from any prepossession. He was never afraid of his facts or of framing any hypothesis, however startling, which seemed to explain them. However much weight he attributed to inheritance as a factor in organic pheno-

mena, tradition went for nothing in studying them. In any one else such an attitude would have produced much work that was crude and rash. But Mr. Darwin—if one may venture on language which will strike no one who had conversed with him as overstrained—seemed by gentle persuasion to have penetrated the reserve of nature which baffles smaller men. In other words, his long experience had given him a kind of instinctive insight into the method of attack of any biological problem, however unfamiliar to him, and he rigidly controlled the fertility of his mind in hypothetical explanations by the no less fertility of ingeniously-devised experiment. Whatever he touched he was sure to draw from it something that it had never before yielded, and he was wholly free from that familiarity which comes to the professed student in every branch of science, and blinds the mental eye to the significance of things which are overlooked because always in view.

The simplicity of Mr. Darwin's character pervaded his whole method of work. Alphonse de Candolle visited him in 1880 and felt the impression of this. "He was not one of those who would construct a palace to lodge a laboratory. I sought out the greenhouse in which so many admirable experiments had been made on hybrids. It contained nothing but a vine." There was no affectation in this. Mr. Darwin provided himself with every resource which the methods of the day or the mechanical ingenuity of his sons could supply, and when it had served its purpose it was discarded. Nor had he any prepossession, in favour of one kind of scientific work more than another. His scientific temperament was thoroughly catholic and sympathetic to anything which was not a mere regrinding of old scientific dry bones. He would show his visitors an *Epipactis* which for years came up in the middle of a gravel walk with almost as much interest as some new point which he had made out on a piece of work actually in hand. And though he had long abandoned any active interest in systematic work, only a few months before his death he had arranged to provide funds for the preparation of the new edition of Steudel's Nomenclator, which, at his earnest wish, has been projected at Kew.

(To be continued.)

MASCART AND JOUBERT'S "ELECTRICITY AND MAGNETISM"

Leçons sur l'Électricité et la Magnétisme. Par E. Mascart et J. Joubert. Tome I. (Paris, 1882.)

MANY of our readers must already be familiar with the "Électricité Statique" of M. Mascart. They will therefore turn with high expectations to the perusal of the "*Leçons sur l'Électricité et le Magnétisme*," of which he is one of the authors. On the whole they will not be disappointed. They will find in it all the limpid clearness, all the vivacity, all the elegance of presentation, both spiritual and material, that characterise the best French text books; and they will find withal none of the shallowness with which their grudging admirers have been wont to credit them. It is a wonderful national gift that our Gallic neighbours have—their power of scientific exposition. We Britons, with a stray exception, are far behind them; still farther are our German cousins. Notwithstanding our undoubted kinship in language and